CONTRIBUTIONS

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CUSHMAN LABORATORY

FOR

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MARCH, 1929

SHARON, MASSACHUSETTS, U. S. A.

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CONTENTS

These contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

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CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

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70. KYPHOPYXA, A NEW GENUS FROM THE CRETACEOUS OF TEXAS

By JOSEPH A. CUSHMAN

In her paper entitled "Foraminifera of the Cretaceous of Central Texas" (Univ. Texas Bull. 2612, 1926, p. 41, pl. 6, fig. 7), Mrs. Carsey described and figured one of the common species of the Taylor Marl and Austin Chalk as *Frondicularia christneri*. The description and figure call attention to some of the characters of this species, but the details of the development and their significance are worthy of further elucidation. Large series of this species from numerous localities and horizons in Texas as well as elsewhere have made possible the comparative study of exteriors as well as sections. The species, which is a very unique one, developed in the Upper Cretaceous seas of Texas and the general region of deposition, is a very specialized one, and became extinct by Middle Taylor time. For it the following genus is erected:

Genus KYPHOPYXA Cushman, new genus

Genoholotype, *Frondicularia christneri* CARSEY

Test consisting of numerous chambers, a globular proloculum followed by a very few chambers, usually only two or three as in *Flabellina*, in a flattened, partial coil at one side, immediately followed by a series of alternating chambers, extending farther and farther back as added and often overlapping below the proloculum, these in turn followed by chambers as in *Frondicularia*,

extending back on each side of the earlier portion, and in this genus the ends often meeting and overlapping at the base of the test; sutures distinct and usually somewhat limbate, the earlier ones standing up far above the walls of the chamber; wall calcareous, finely perforate; aperture terminal, radiate.

This genus very evidently developed from *Flabellina*, species of which are very abundant in these formations. It resembles *Plectofrondicularia* in its developmental stages, but the aperture is radiate as in the Lagenidae, and there is developed the peculiar small apertural chamberlet so characteristic of this group (see these Contributions, vol. 4, pt. 1, 1928, "Apertural Characters in the Lagenidae"). The early chambers are planispirally coiled as in the young of *Flabellina*, but the next series are alternating on the opposite sides of the axis, the apertural end projecting, but at the base, especially in the megalospheric form, the chambers overlap the preceding ones until in some specimens they meet and regularly overlap at the base as shown (Pl. 1, figs. 1 and 2). This same character continues in adult chambers which, like those of *Frondicularia*, extend back on the two sides but overlap regularly at the base.

In the microspheric form the early growth consists of more chambers, the earlier stages being held longer and the chambers not encircling the base. As usual, the microspheric form reaches the larger size, but does not advance to the development shown by the megalospheric form. It is another example of the fact that I have so often stressed that the microspheric form is retrospective, passing through many of the stages which represent the early development of its family history, and reaching a large size while the megalospheric form is progressive, passing through its early stages quickly, usually in a reduced form, and often leaving out some of the stages entirely, not reaching so

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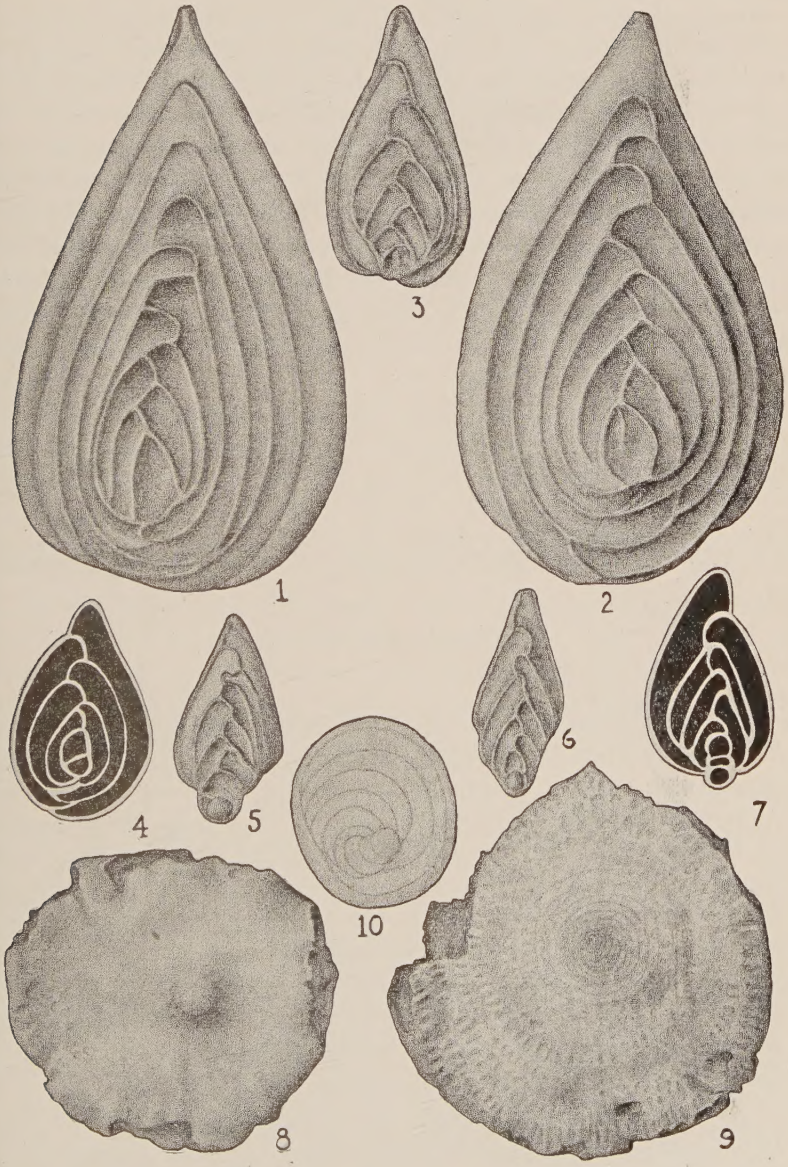
EXPLANATION OF PLATE 1

FIGS. 1–7. *Kyphopyxa christneri* (Carsey). × 45. Figs. 1, 2, Adult megalospheric forms. Figs. 3-7, Young stages with alternating chambers, 4 and 7 sections.

FIGS. 8–10. *Cycloloculina jarvisi* Cushman, new species. Fig. 8, Megalospheric adult, × 55. Fig. 9, Microspheric adult, × 55. Fig. 10, Early chambers of microspheric form, × 150.

Figures drawn by Margaret S. Moore.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large a size but in its final development often adding new characters not reached by the microspheric form at all.

In the earlier stages especially of the megalospheric form, the sutural projections are very high with deep depressions between. In later development the sutures are marked by a lessened height and in the later growth the sutures are even depressed. The early development of the species is shown in some of the earlier formations, and a close study of these especially may show that there are definite varieties with characters which can be recognized in the various formations in which the species occurs.

Kyphopyxa christneri has been noted from Texas, Arkansas and Florida, particularly in beds of Lower Taylor age. At its height of development it was widely distributed and often very abundant.

71. CYCLOLOCULINA IN THE WESTERN HEMISPHERE

By Joseph A. Cushman

Two very interesting and closely related genera are *Cycloloculina* Heron-Allen and Earland and *Sherbornina* Chapman. Both genera are apparently exceedingly rare. *Cycloloculina* is known from two species, *C. annulata* and *C. polygyra*, both described by the authors from the southern coast of England near Selsey, the material probably coming from Eocene beds along the coast. Through the kindness of Mr. Heron-Allen, I have slides in my collection of both of these species showing the developmental stages. *Sherbornina* is represented by the single species, *S. atkinsoni* Chapman, from the Miocene of Table Cape, Tasmania. Of this species I also have a series of specimens from the type locality through the kindness of Mr. W. J. Parr.

With this material at hand for study, it is interesting to find in collections made in Trinidad by Mr. P. W. Jarvis several specimens evidently belonging to this group. They represent a single species different from any of the three mentioned above and make the first record for this group in the Western Hemisphere. The species may be described as follows:

CYCLOLOCULINA JARVISI Cushman, new species
Plate 1, figures 8-10

Test discoid, in the microspheric form slightly concave in the middle and thickening toward the periphery, which forms the thickest part of the test, in the megalospheric form with the central portion slightly convex then thinning and again thickening toward the periphery; chambers of the earliest portion in a coil; in the microspheric form of several elongate chambers, in the megalospheric form of a few broader chambers, the coiled series in either case followed by annual chambers, not subdivided; sutures not distinct except when the test is wet; wall calcareous, rather coarsely perforate; apertures formed by the large perforations of the test. Diameter of microspheric adult about 1 mm.

Holotype (Cushman Coll. No. 10095) from Eocene deposits, Lothian Estate, Trinidad, B. W. I., collected by P. W. Jarvis.

These specimens were possibly attached as one side is slightly more flattened than the other and the wall somewhat thinner so that the earlier chambers can be seen more readily than from the other side which has a thicker wall. The outer, thicker wall has somewhat the appearance of *Sherbornina*, but does not have the true outer layer of spathulate chambers characteristic of that genus. In the Trinidad species the annular chambers are more numerous and closer together than in the English species and the early coiled chambers more elongate and narrower. There is no sign of a spinose periphery as in *C. annulata*.

The occurrence of these four species of two allied genera from such remote localities would indicate that these forms have been overlooked. At first glance they might easily be mistaken for young specimens of *Discocyclina*, but a closer examination would quickly reveal their true character.

As noted by Heron-Allen and Earland, Terquem in his work on the Eocene Foraminifera of the Paris Basin figures under *Planorbulina*, several specimens which may possibly belong to this genus, particularly Plate XI, figures 15-19. Allowing for the peculiar character of the figures in this work, these may possibly all be of this genus. A study of a few of Terquem's species in Paris convinced me that very little could be done with many of Terquem's species without reference to the actual type specimens which are carefully labelled. Enough is shown however in these figures to make it very probable that *Cycloloculina* is to be found in material from the Paris Basin Eocene.

72. NEW FORAMINIFERA FROM TRINIDAD

By Joseph A. Cushman and P. W. Jarvis

In the Trinidad material collected by Mr. Jarvis, there are many striking new species, some of which it seems best to describe before the description of the entire faunas is published. A few of these are given below:

TEXTULARIA LIRATA Cushman and Jarvis, new species
Plate 2, figures 4 *a*, *b*

Test greatly compressed, widest at the apertural end, periphery acute; chambers comparatively few, 8 or 9 pairs, 2 or 3 times broader than high, the periphery of each somewhat spinose, the outer edge slightly thickened and plicate with oblique furrows running backward and becoming more oblique toward the periphery; sutures very distinct but not depressed, curved; wall finely and uniformly arenaceous, occasionally with larger fragments, exterior smooth; aperture very elongate, deep, in the median line. Length 1.25 mm.; breadth 1.40 mm.; thickness 0.10 mm.

Holotype (Cushman Coll. No. 10084) from the "Sagrina beds", Trinidad Point, Oropouche Lagoon.

This is a very striking species with its compressed form, evenly arenaceous test with the oblique furrows in the outer portion of each chamber.

GAUDRYINA DISJUNCTA Cushman and Jarvis, new species
Plate 2, figures 7 *a*, *b*

Test elongate, the early chambers triserial and closely set, later ones becoming irregularly biserial and more loosely arranged, somewhat polyhedral in shape in the later portion; sutures of the earlier portion indistinct, becoming deeper and more distinct later; wall coarsely arenaceous, almost completely of clear grains of varying sizes, with a very small proportion of cement, but the surface fairly smooth and firm; aperture in the adult becoming somewhat terminal, rounded, in a depression of the face, surrounded by a slightly raised border. Length up to 1.15 mm.; breadth 0.75 mm.

Holotype (Cushman Coll. No. 10097) from the Eocene, "Bamboo Clay" of the Cipero Section, Trinidad.

This species in some respects resembles some of the species described by Fornasini from the Tertiary of Italy but is a stouter, more disjointed species, with somewhat more polyhedral chambers.

PLANULARIA CLARA Cushman and Jarvis, new species
Plate 2, figures 14, 15

Test much compressed, the sides nearly parallel, close coiled, the periphery keeled and a keel at either side; chambers very distinct, few, the whole test with from 1 to 2 coils, regularly increasing in size as added; sutures very distinct, the spiral suture slightly raised but very narrow, sutures between the chambers slightly curved, strongly limbate, broadening rapidly toward the periphery, of clear shell material; wall smooth, very finely perforate; aperture at the upper angle of the face of the chamber, radiate, with the ventral ray enlarged and elongate. Length 0.90 mm.; breadth 0.30-0.40 mm.; thickness 0.06-0.08 mm.

Holotype (Cushman Coll. No. 10098) from "Sagrina beds", Lothian Estate, Trinidad.

This is a very beautiful species with very broad, clear, limbate sutures increasing in width toward the periphery.

VAGINULINA SENTICOSA Cushman and Jarvis, new species
Plate 2, figures 5, 6

Test elongate, tapering from a subacute initial end which has a stout spire, to the greatest breadth at the last-formed chamber, the early portion somewhat compressed, especially in the microspheric form, later portion inflated and the chambers rounded in section; sutures fairly distinct, slightly limbate; wall of the early portion smooth, later with large spines which are arranged in somewhat regular, longitudinal series, in some specimens coalescing to form spinose ribs; aperture near one side, terminal, with a distinct tubular neck. Length 1.50 mm.; breadth 0.35 mm.

Holotype (Cushman Coll. No. 10077) from "Eocene Bamboo Clay", Cipero Section, Trinidad.

This is a large and strikingly ornamented species showing considerable variation as is usual in this family.

LAGENA LACUNO-COSTATA Cushman and Jarvis, new species
Plate 2, figures 8, 9

Test with the base truncate, the sides convexly curving to the slender elongate neck, circular in transverse section, basal view showing 1 to 3 spines at the center with a ring of 5 or 6 about them, and another row at the periphery, the sides of the test with evenly spaced, longitudinal costae, slightly raised, the areas between conspicuously pitted, neck smooth. Length 0.65 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 10076) from "Bamboo Clay", Cipero Section, Trinidad.

The form and ornamentation of this species are constant with the exception of variation in the number of the spines which apparently are more complex in the larger specimens.

LAGENA PULCHERRIMA Cushman and Jarvis, new species
Plate 2, figure 10

Test large for the genus, somewhat compressed, base broadly rounded, tapering gradually to the somewhat extended, apertural end, periphery subacute, central portion of the broad faces made

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EXPLANATION OF PLATE 2

FIGS. 1–3. *Plectofrondicularia spinifera* Cushman and Jarvis, n. sp. × 55. Fig. 1, Adult. Fig. 2, Early stages. Fig. 3, Final chamber.

FIGS. 4 *a*, *b*. *Textularia lirata* Cushman and Jarvis, n. sp. × 42. *a*, front view; *b*, apertural view.

FIGS. 5, 6. *Vaginulina senticosa* Cushman and Jarvis, n. sp. × 42.

FIGS. 7 *a*, *b*. *Gaudryina disjuncta* Cushman and Jarvis, n. sp. × 42. *a*, front view; *b*, apertural view.

FIGS. 8, 9. *Lagena lacuno-costata* Cushman and Jarvis, n. sp. × 55.

FIG. 10. *Lagena pulcherrima* Cushman and Jarvis, n. sp. × 55.

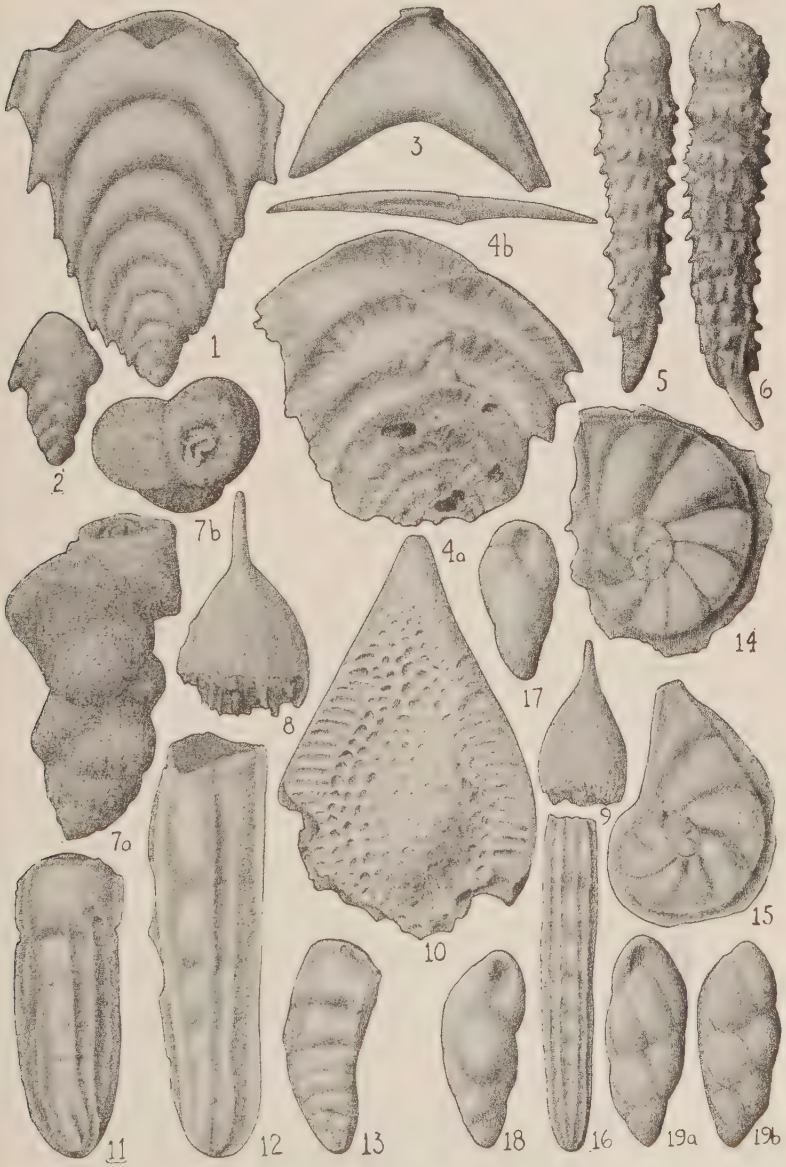
FIGS. 11–13. *Plectofrondicularia paucicostata* Cushman and Jarvis, n. sp. Figs. 11, 12, × 35. Fig. 13, × 42.

FIGS. 14, 15. *Planularia clara* Cushman and Jarvis, n. sp. × 55.

FIG. 16. *Plectofrondicularia trinitatensis* Cushman and Jarvis, n. sp. × 55.

FIGS. 17–19. *Buliminella basistriata* Cushman and Jarvis, n. sp. × 85. Figs. 19 *a*, *b*, opposite sides.

Figures drawn by Margaret S. Moore.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up of an irregular, hexagonal network, the basal portion of each area with a deep opening, convex above, the remainder of each hexagonal area with a thin covering wall, the peripheral portion of the surface with elongate areas, with a similar series of openings; aperture circular, at the end of the neck. Length 1.35 mm.; breadth 0.80 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 10075) from "Green Clay", Cipero Section, Trinidad.

This extravagantly ornamented species is somewhat allied to the species with hexagonally marked areas such as *L. striato-areolata* Rymer Jones, *L. squamoso-marginata* (Parker and Jones), and *L. squamoso-alata* H. B. Brady, but is far more and differently ornamented than any of these.

PLECTOFRONDICULARIA SPINIFERA Cushman and Jarvis, new species
Plate 2, figures 1-3

Test much compressed, roughly rhomboid, initial end narrow, greatest width at the last-formed chamber, periphery acute; chambers in the earliest stages alternating followed by arched chambers not overlapping the earlier ones, the peripheral angles extended into a short spine, gradually increasing in size as added, the central portion slightly inflated, depressed toward the sutures and periphery; sutures distinct, depressed and very slightly limbate; wall smooth, finely perforate; aperture terminal, elliptical, without teeth or radiating slits, with a slight neck and lip. Length 1.20 mm.; breadth 0.85 mm.

Holotype (Cushman Coll. No. 10086) from "Bamboo Clay", Cipero Section, Trinidad.

This is a very interesting species allied very closely to *P. packardi*, var. *spinata* Cushman and Schenck from the Keasey Shale of Oregon. The Trinidad species is broader and the spines are a more distinct unit, rather than prolongations of the body of the chamber.

PLECTOFRONDICULARIA PAUCICOSTATA Cushman and Jarvis, new species
Plate 2, figures 11-13

Test fairly large, somewhat compressed, earliest chamber in an alternating series but soon becoming uniserial and usually in a straight line; chambers distinct but very little inflated, few in

number; sutures slightly depressed, distinct; wall ornamented by a few very high, thin, longitudinal costae, independent of the chambers, continuing to the apertural end or becoming obsolete except those of the peripheral border which are most persistent; aperture elongate, subelliptical, the ends somewhat narrowed to a point, without teeth. Length of largest specimen 2 mm.; breadth 0.50 mm.; thickness 0.35 mm.

Holotype (Cushman Coll. No. 10073) from "Bamboo Clay", Cipero Section, Trinidad.

This is a large stout species with very high thin costae and the early biserial stage greatly reduced.

PLECTOFRONDICULARIA TRINITATENSIS Cushman and Jarvis, new species
Plate 2, figure 16

Test elongate, sides nearly parallel except at the initial end, which is slightly tapering, initial end subacute; chambers in the earliest portion, biserial, quickly becoming uniserial in all the later development, numerous, increasing in height as added, early ones with the sutures sloping to the sides and the chambers much broader than high, in the adult the sutures more nearly transverse and the chambers becoming higher than broad; sutures slightly depressed, distinct; wall ornamented by several distinct, low, sharp costae, continuous from the initial to the apertural end, one at each periphery with 4 or 6 on either side of the test and occasionally another in the median line; aperture elliptical. Length up to 1 mm. or slightly more; breadth 0.18 mm.; thickness 0.08 mm.

Holotype (Cushman Coll. No. 10064) from Eocene, Mount Moriah Beds, Vistabella Quarry, Trinidad.

This species has a larger number and more persistent costae than the later ones of its group which are found in Trinidad, Mexico and the United States. The vertical range of these various species is very limited, and they make excellent index fossils.

BULIMINELLA BASISTRIATA Cushman and Jarvis, new species
Plate 2, figures 17-19

Test small, tapering, with the greatest width usually toward the apertural end, 3 to 5 chambers in a coil, fairly distinct, very

slightly inflated; sutures distinct, slightly depressed; wall smooth, except for the earliest portion, which is finely striate; aperture comparatively large, broadest toward the inner end, slightly oblique. Length 0.30-0.40 mm.; breadth 0.15 mm.

Holotype (Cushman Coll. No. 10101) from Eocene, Mt. Moriah beds of Vistabella Quarry, Trinidad.

This is a small, but distinct species, and occurs in the Upper Eocene of South America also.

UVIGERINELLA PARVA Cushman and Jarvis, new species

Plate 3, figures 7 *a*, *b*

Test small, fusiform, about twice as long as broad, greatest breadth slightly above the middle; chambers numerous, rapidly increasing in size as added, slightly inflated, distinct; sutures distinct, slightly depressed; wall smooth, on the initial end barely striate; aperture rounded or slightly polygonal, with a very short neck often somewhat open on the inner margin. Length 0.33 mm.; breadth 0.16 mm.

Holotype (Cushman Coll. No. 10102) from Eocene, Mount Moriah beds of Vistabella Quarry, Trinidad.

This is a small but distinctive species, occurring here and in other localities with *Hantkenina*.

UVIGERINA SPINICOSTATA Cushman and Jarvis, new species

Plate 3, figures 9, 10

Test elongate, the microspheric form tapering, the megalospheric form quickly reaching its full width; chambers inflated, fairly numerous, distinct, especially the later ones; sutures in the later portion distinct and depressed; wall ornamented by numerous, high, plate-like costae, those of each chamber independent, in the earlier portion broken up into spinose projections and sometimes on the later chambers, especially the basal portion of the costae; aperture with a stout neck and lip, the neck spinose. Length of microspheric form 0.90 mm.; breadth 0.30 mm.

Holotype (Cushman Coll. No. 10061) from Lower Marl, Cipero Section, Trinidad.

This is a very distinctive species, in shape, and ornamentation.

UVIGERINA SERIATA Cushman and Jarvis, new species
Plate 3, figures 11, 12

Test elongate, tapering, greatest width formed by the last-formed chamber, initial end subacute, tapering sharply even in the megalospheric form; chambers numerous, distinct, inflated, the later ones tending to become uniserial; sutures distinct, depressed; wall ornamented by very numerous, slightly raised costae, somewhat anastomosing and mostly continuous over several chambers, some of the costae at the basal portion of each chamber forming short spines; aperture circular with a cylindrical, smooth neck and phialine lip. Length 0.90 mm.; breadth 0.38 mm.

Holotype (Cushman Coll. No. 10062) from "Sagrina beds" of Trinidad Point, Oropouche Lagoon, Trinidad.

The shape and ornamentation will distinguish this species.

UVIGERINA CURTA Cushman and Jarvis, new species
Plate 3, figures 13-15

Test very short and stout, only slightly longer than broad; chambers few, inflated; sutures depressed, the earlier ones largely obscured by the ornamentation; wall of the earlier portion with very high, thin, sharp costae, mostly entire, some independent on each chamber, others continuous, last-formed 1 or 2 chambers smooth; aperture circular, with a smooth neck set into a distinct depression of the chamber, usually the neck with a thin, flaring lip, somewhat sinuous instead of in one plane. Length 0.60 mm.; breadth up to 0.45 mm.

Holotype (Cushman Coll. No. 10057) from Eocene Shales just North of Point Bontour, Trinidad.

This is a peculiar and well characterized species, and several have had double apertures as shown in Pl. 3, fig. 13.

SIPHOGENERINA BASISPINATA Cushman and Jarvis, new species
Plate 3, figures 4, 5

Test elongate, about 3 times as long as broad, early portion triserial and tapering, later portion uniserial, sides nearly parallel; chambers comparatively few, fairly distinct, not inflated; sutures distinct, not depressed; wall ornamented in the later portion by a series of distinct, plate-like, longitudinal costae, somewhat unevenly placed, continuous over the chambers,

but over the early portion projected into spine-like processes; aperture circular, with a smooth cylindrical neck and phialine lip. Length 0.85 mm.; breadth 0.30 mm.

Holotype (Cushman Coll. No. 10054) from "Sagrina beds" of Trinidad Point, Oropouche Lagoon, Trinidad.

This is a striking species with the irregular longitudinal costae and spinose base.

SIPHOGENERINA MULTICOSTATA Cushman and Jarvis, new species
Plate 3, figure 6

Test elongate, about 3 times as long as broad, early portion triserial, slightly tapering, whole test somewhat fusiform, greatest width at about the middle; chambers distinct, slightly inflated; sutures distinct, slightly depressed; wall ornamented with numerous longitudinal costae, not greatly raised and those of each chamber mostly independent of those of adjacent chambers, early chambers with distinct short spines not confluent with the later costae; aperture circular, with a cylindrical neck and wide thin lip. Length 0.80 mm.; breadth 0.27 mm.

Holotype (Cushman Coll. No. 10056) from "Green Clay", Cipero Section, Trinidad.

EXPLANATION OF PLATE 3

FIGS. 1 *a*, *b*. *Cassidulina spinifera* Cushman and Jarvis, n. sp. × 55. *a*, side view; *b*, apertural view.

FIGS. 2, 3. *Hantkenina alabamensis* Cushman, var. *primitiva* Cushman and Jarvis, n. var. × 75.

FIGS. 4, 5. *Siphogenerina basispinata* Cushman and Jarvis, n. sp. × 55.

FIG. 6. *Siphogenerina multicostata* Cushman and Jarvis, n. sp. × 55.

FIGS. 7 *a*, *b*. *Uvigerinella parva* Cushman and Jarvis, n. sp. × 85. *a*, *b*, opposite sides.

FIG. 8. *Hantkenina lehneri* Cushman and Jarvis, n. sp. × 55.

FIGS. 9, 10. *Uvigerina spinicostata* Cushman and Jarvis, n. sp. × 55.

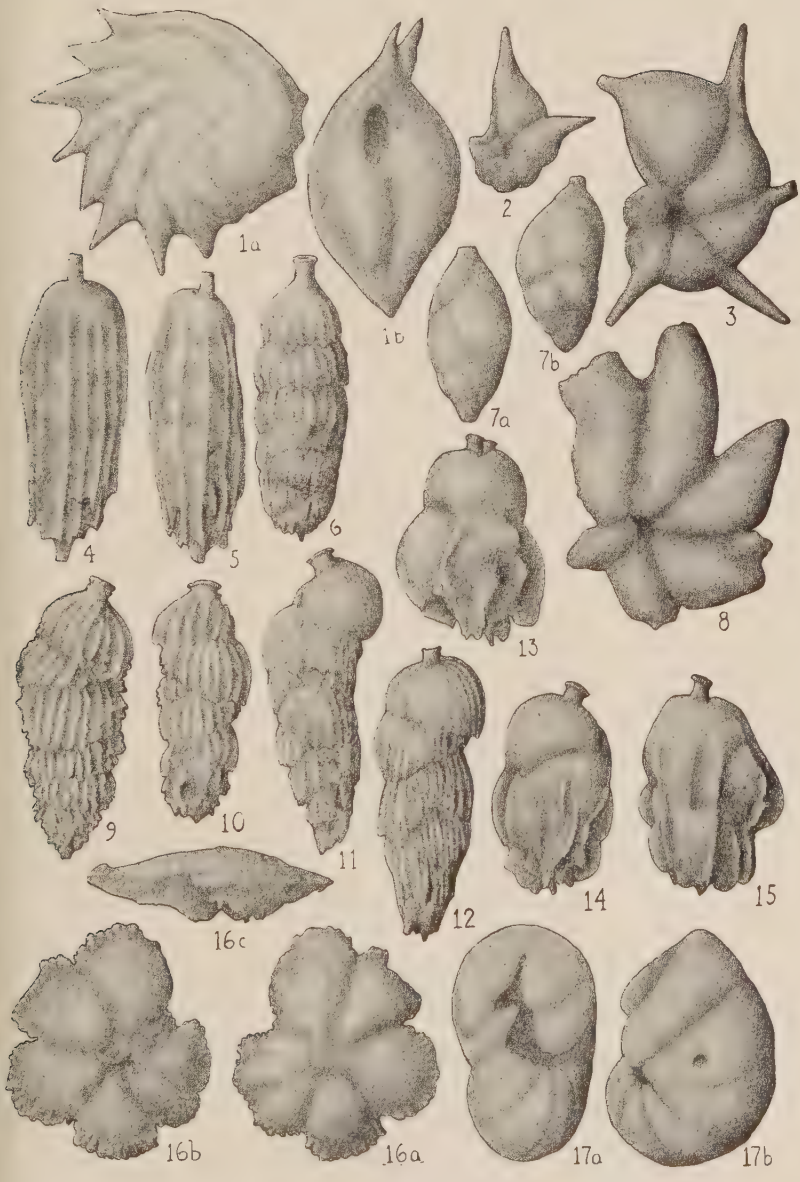
FIGS. 11, 12. *Uvigerina seriata* Cushman and Jarvis, n. sp. × 55.

FIGS. 13–15. *Uvigerina curta* Cushman and Jarvis, n. sp. × 55. Fig. 13, Specimen with double aperture.

FIGS. 16 *a–c*. *Globorotalia lehneri* Cushman and Jarvis, n. sp. × 55. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 17 *a*, *b*. *Ceratobulimina evoluta* Cushman and Jarvis, n. sp. × 60. *a*, apertural view; *b*, side view.

Figures drawn by Margaret S. Moore.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This is a very distinct species from the preceding in nearly all its characters. It is rather unusual in this genus for the ornamentation of the chambers to be distinct and not confluent.

HANTKENINA LEHNERI Cushman and Jarvis, new species

Plate 3, figure 8

Test planispiral, usually consisting of 6 chambers in the last-formed coil, increasing in size as added, the outer end produced, peculiarly contracted, and either truncate or ending in a stout spine; chambers sometimes almost cylindrical; sutures distinct, depressed; wall smooth; aperture usually filled and indistinct in all the specimens examined. Length up to 1 mm.

Holotype (Cushman Coll. No. 10071) from Eocene, Lowest Marl, near source of Moruga River, Trinidad, collected by Dr. E. Lehner.

This species most nearly resembles *Hantkenina mexicana* Cushman, but is much more irregular in shape and the chambers more nearly cylindrical.

HANTKENINA ALABAMENSIS Cushman, var. PRIMITIVA Cushman and Jarvis, new variety

Plate 3, figures 2, 3

Variety differing from the typical in the later taking on of the spinose, inflated chambers, the early chambers of the final coil usually without spines, globular and roughened.

Holotype of variety (Cushman Coll. No. 10067) from Eocene, Mt. Moriah beds, Vistabella Quarry, Trinidad.

In South America this form occurs also in beds of probably equivalent age. Some of the specimens show but a few of the later typical *Hantkenina* chambers.

CERATOBULIMINA EVOLUTA Cushman and Jarvis, new species

Plate 3, figures 17 *a*, *b*

Test trochoid, close coiled, except the last chamber, which in the adult, forms the beginning of a loose coil, periphery broadly rounded; chambers distinct, not inflated, 7 or 8 in the final whorl; sutures distinct, somewhat limbate in some specimens; wall smooth and polished; aperture large, the narrow, inner end extending to the middle of the apertural face, widening toward the base, no covering plate evident in any of the specimens seen. Length 0.60 mm.; breadth 0.45 mm.; thickness 0.38 mm.

Holotype (Cushman Coll. No. 10103) from "Bamboo Clay" of Cipero Section, Trinidad.

This is an unusual species in the uncoiling character in the later growth.

CASSIDULINA SPINIFERA Cushman and Jarvis, new species

Plate 3, figures 1 *a*, *b*

Test nearly circular in side view, the periphery broken by the stout spines at the outer end of each chamber, in apertural view broadly fusiform, the ends becoming acute, the spines not in a single plane but alternating slightly from side to side, last-formed chamber smooth, without spines; sutures strongly curved, somewhat limbate, flush with the surface, of clear shell material; aperture large and broad for the genus in a distinct depression, nearly in the axis of coiling. Diameter with spines 0.85 mm.; thickness 0.40 mm.

Holotype (Cushman Coll. No. 10069) from Upper Marl, Cipero Section, Trinidad.

This species is most nearly related to *C. elegantissima* Cushman from the Pacific, but lacks the ornamentation of that species.

GLOBOROTALIA LEHNERI Cushman and Jarvis, new species

Plate 3, figures 16 *a-c*

Test trochoid, very much compressed, composed of 6 or 7 chambers in the last-formed whorl, ventral side umbilicate; chambers distinct, inflated, the periphery of each with a thin keel, distinctly spinose; sutures distinct, depressed; wall smooth except for the keel and about the umbilicus which has a series of distinct spines; aperture ventral, opening into the umbilicus. Diameter 0.36 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 10068) from Eocene, Lower Marl, near source of Moruga River, Trinidad, collected by Dr. E. Lehner.

This is a strikingly ornamented species and in the series of specimens examined is rather constant in its characters.

73. ON ELPHIDIUM MACELLUM (FICHTEL AND MOLL), E. STRIATO-PUNCTATUM (FICHTEL AND MOLL) AND E. CRISPUM (LINNÉ)

By Joseph A. Cushman and David H. Leavitt

These three species, among the oldest of the genus, have often not been used in the sense of the authors. The "*Polystomella striato-punctata*" of most authors if not all since the time of Fichtel and Moll is not the same as that of the original authors. In order more clearly to fix these three species, the names of which are very widely used in the literature, topotype material was studied in connection with the earlier figures and descriptions. The tendency to take up a later author's idea of a species without recourse to the original is nowhere more strikingly illustrated than in this group. The three species will be taken up separately and their characters described in detail. The figures are copies from Fichtel and Moll, and drawings of original specimens considered to be typical, from as near the type locality as possible. No attempt is made to give complete synonymy which is impossible without a study of the original material of various authors' collections. The main point of the study is to try to fix as accurately as possible what should be taken as the typical form for each of these three species.

ELPHIDIUM MACELLUM (Fichtel and Moll)

Plate 4, figures 1, 2

Nautilus macellus Fichtel and Moll, Test. Micr., 1798, p. 66, var. β, figs. *h-k*.

Elphidium macellum Montfort, Conch. Syst., vol. 1, 1808, p. 15, 4e genre.

Test of medium size for the genus, about 3½ times longer than wide in peripheral view, lenticular, planispiral, completely involute, umbilical regions flat, periphery angular, slightly more rounded in the last-formed chambers, slightly keeled, somewhat lobulate; chambers numerous, averaging 17 in adults in the last-formed coil, slightly arched giving a ribbed appearance to the test; sutures slightly depressed, those of the last-formed chambers slightly more so, partially obscured by the retral

processes, curved backward strongly toward the periphery, the proximal half nearly radial, set with indistinct pores; wall thin, finely perforate, usually with less than 12 relatively long retral processes, more widely spread than in *E. crispum* and extending from well up on the side of the chamber to the front of the preceding and appearing as narrow, fairly widely spaced, low elevations of the wall; aperture, a row of small openings between the retral processes at the base of the apertural face which is convex, sagittate, with the sides slightly convex, the lobes sharply angled, saddling the preceding coil. Diameter typically less than 1 mm.; thickness 0.25 mm.

The types of Fichtel and Moll were from "Zoophytic Concretions" from the Mediterranean. Our figured specimen is from Rimini, Italy, on the Adriatic. The species is apparently common in the Adriatic and the Mediterranean as we have it from other localities besides Rimini.

The aperture is not, as shown by Fichtel and Moll, a small opening at the upper end of the apertural face, but a series of rounded openings at its base.

ELPHIDIUM STRIATO-PUNCTATUM (Fichtel and Moll)

Plate 4, figures 5, 6

Nautilus striato-punctatus FICHTEL and MOLL, Test. Micr., 1798, p. 61, pl. 9, figs. *a-c.*

Test of moderately large size for the genus, about twice as long as wide in peripheral view, the periphery broadly rounded, completely involute, umbilical regions flat or very slightly concave; chambers numerous, averaging 25 in the adult, later ones becoming somewhat wider than the earlier ones, last few chambers becoming inflated, forward part slightly raised, giving a radially ribbed appearance; sutures partly obscured by the retral processes, slightly depressed and indistinct in the earlier ⅔ of the coil, rather deeply depressed and distinct in the last part, earlier sutures nearly radial, later ones slightly and nearly symmetrically bowed forward, set with pores which are rather indistinct in the earlier part but large and deep on the last few sutures; wall finely perforate, with usually 12 relatively short, closely spaced retral processes which appear to extend across the radial lines so that the processes form a more or less continuous line in the direction of coiling, appearing as low elevations in the earlier chambers, but in the last ones as relatively thick rod-

like structures; aperture, a row of small openings at the base of the apertural face (not a narrow slit as figured by Fichtel and Moll), apertural face slightly convex, crescentic, the sides ending in blunt points. Diameter of largest specimens 1 mm.; thickness 0.40 mm.

The types of Fichtel and Moll are given as from the Arabian Gulf. Our figured specimen is from the Red Sea where the typical form with broadly rounded periphery, with a broad test in side view, and many chambers is often very abundant. This species does not seem to occur in the Mediterranean, and it is to be suspected that its distribution will be found to be confined to very warm, shallow waters of the Red Sea and adjacent parts of the Indian Ocean. To this species very many of the forms referred to it certainly do not belong. As in other species, the last-formed chamber is very thin and probably broken by the formation of the young. For this reason the broader, more typical specimens were not chosen for figuring.

ELPHIDIUM CRISPUM (Linné)

Plate 4, figures 3, 4

"Cornu Hammonis orbiculatum" PLANCUS (BIANCHI), Conch. Min., 1739, p. 10, pl. 1, fig. 2.

"Nautilus minimus" GUALTIERI, Index Test., 1742, pl. 19, figs. A, D.

Nautilus crispus LINNÉ, Syst. Nat., 12th Ed., 1767, p. 1162; Ed. 13 (GMELIN'S), 1788-93, p. 3370.—FICHTEL and MOLL, Test. Micr., 1798, p. 40, pl. 4, figs. *d-f*; pl. 5, figs. *a*, *b*.

Themeon rigatus MONTFORT, Conch. Syst., vol. 1, 1808, p. 203, 51e genre.

Test of large size for the genus, about 2½ times longer than wide in peripheral view, lenticular, completely involute, the um-

EXPLANATION OF PLATE 4

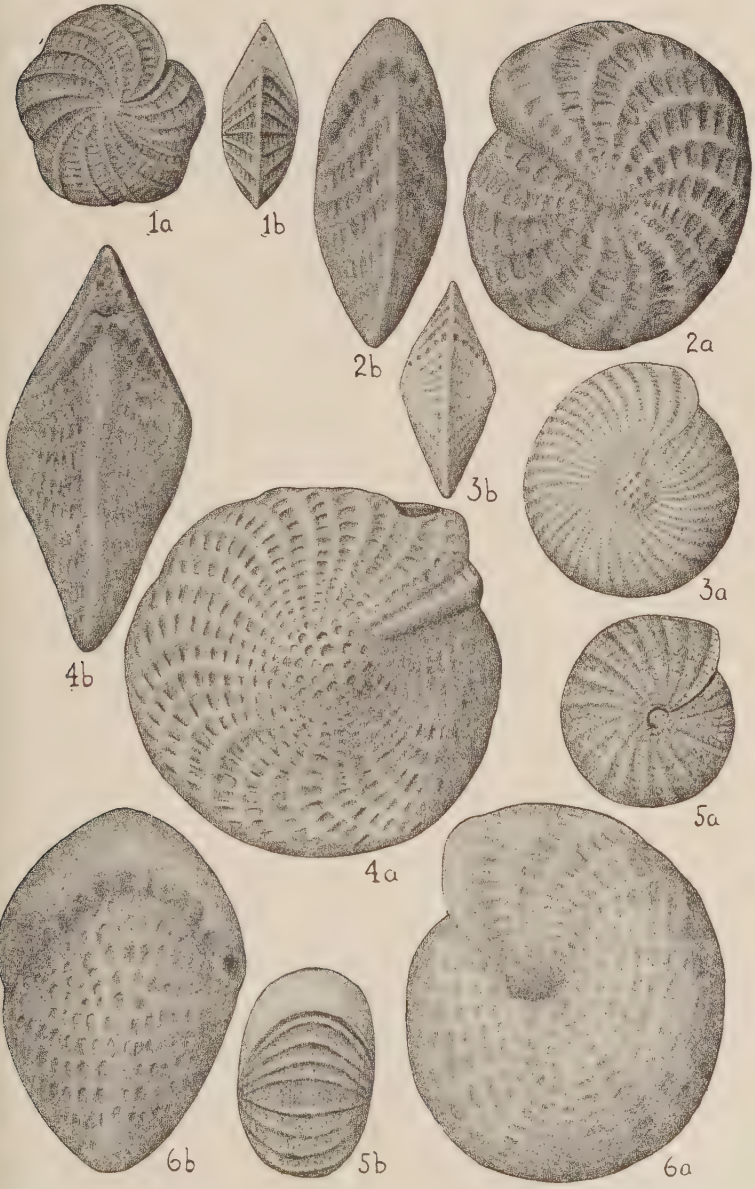
In all figures: *a*, side view; *b*, peripheral view.

FIGS. 1, 2. *Elphidium macellum* (Fichtel and Moll). Fig. 1, After original of Fichtel and Moll, magnification indefinite. Fig. 2, Specimen from Rimini, Italy. × 60.

FIGS. 3, 4. *Elphidium crispum* (Linné). Fig. 3, After original of Fichtel and Moll, magnification indefinite. Fig. 4, Specimen from Rimini, Italy. × 18.

FIGS. 5, 6. *Elphidium striato-punctatum* (Fichtel and Moll). Fig. 5, After Fichtel and Moll, magnification indefinite. Fig. 6, Specimen from Red Sea off Gizon, S. W. Arabia. × 55.

Figures drawn by Margaret S. Moore.


1a
1b
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6b
5b
6a

bilical regions with a medium sized, slightly projecting, rounde boss of clear shell material, the surface of which is set wit 10—12 small, shallow, rounded pits, periphery sharply angula but not sharply keeled, sometimes becoming slightly lobulate an blunter in the last portion of the adult coil; chambers ver numerous, 20—40 in number, long, narrow, the last few ofte inflated, forward part slightly raised, giving a radially ribbe appearance; sutures somewhat sigmoid, the middle portion o each nearly radial, partially obscured by the retral processes, se with pores, those of the earlier ones indistinct but later ones wit large and deep pores; wall finely perforate with about 12 rela tively long retral processes extending well up onto the side o the next added chamber, appearing as fairly widely spaced, lo elevations of the wall in the earlier chambers, but as thicker an more rod-like structures in the later chambers; aperture, a ro of small openings between the retral processes at the base of th apertural face, which is low, sagittate, the sides often slightl concave, the ends pointed. Diameter up to 3 mm.

Linné gives only the Mediterranean as the locality for thi species, but the first two of his references to Bianchi an Gualtieri indicate Rimini on the Adriatic as the locality fro which their figures came. Our figured specimen is from Rimin The species is found in the typical form in the Mediterranea and the Late Tertiary of the same general region. Just ho much more widely distributed this typical form may be, it i necessary to leave to the results of further studies now unde way.

Enough may have been given with the figures to fix these thre species. *E. macellum* has a keeled periphery, often lobulate fewer chambers than the others, and the umbilicus flattened o even depressed. *E. striato-punctatum* has a very stout test wit the periphery very broadly rounded, the umbilical region flat tened or depressed, the number of chambers large and the retra processes confluent in lines parallel to the periphery. *E. crispu* has the umbilical regions with large protuberant bosses wit 10—12 large rounded pits, the periphery angled and the cham bers very numerous.

Our studies have shown that there is a considerable differenc in the size and characters of the microspheric and megalospheri forms and that the changes from young individuals to adults ar often very marked and should be studied for each species.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the oraminifera that have come to hand.

iebus, Adalbert.
Die Tertiärformation in Albanien. Die Foraminiferen.
(Palaeontographica, vol. 70, 1928, pp. 41-114, pl. 5, 49 figs. in text.) *Stuttgart.*
Many of the species of the Tertiary of Albania are figured in section, and show the early stages. A few new species are described.

iebus, Adalbert.
Zur Stammesgeschichte der Foraminiferen.
(Pal. Zeitschr., vol. 10, 1928, pp. 130-135, figs. 1-15 in text.) *Berlin.*
A discussion with figures of some of the relationships in the foraminifera.

ushman, Joseph A. and Hubert G. Schenck.
Two Foraminiferal Faunules from the Oregon Tertiary.
(Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 17, 1928, pp. 305-324, pls. 42-45.) *Berkeley.*
The Tertiary foraminifera of two areas are figured and described. A few of them are new.

ofker, J.
Die Foraminiferen aus dem Senon Limburgens. IX. *Polyiragma cribrosum* Reuss.
(Nat. Maan. Nat. Gen. Limburg, Jaarg. 17, No. 7, July 27, 1928, pp. 105-108, 1 pl.) *Limburg.*
The detailed structure and especially the early development of this species are given with a discussion of the relationships to other genera.

ushman, Joseph A.
Foraminifères du Stampien du Bassin de Paris.
(Bull. Soc. Sci. Seine-&-Oise, ser. 2, vol. 9, 1928, pp. 47-57, pls. 1-3.) *Versailles.*
Five new species and varieties are described and figured among others.

Galloway, J. J. and Bruce H. Harlton.
Some Pennsylvanian Foraminifera of Oklahoma, With Special Reference to the Genus Orobias.
(Journ. Pal., vol. 2, 1928, pp. 338-357, pls. 45, 46.) *Bridgewater.*

Nine new species and a new genus *Tuberitina* are described with others.

Cushman, Joseph A. and James A. Waters.
Upper Paleozoic Foraminifera from Sutton County, Texas.
(Journ. Pal., vol. 2, 1928, pp. 358-371, pls. 47-49.) *Bridgewater.*

Ten new species, a new genus *Spandelina*, and subgenus *Spandelinoides*, are described with others.

Nuttall, W. L. F.
Notes on the Tertiary Foraminifera of Southern Mexico.
(Journ. Pal., vol. 2, 1928, pp. 372-376, pl. 50.) *Bridgewater.*

Four new species are described.

Lacroix, Eugene.
Du choix des Coccolithes par les Foraminifères Arénacés pour l'Édification de leur tests.
(Compte rendu Congrès Lyon Assoc. Francaise Avan. Sci., 1926 (1927), pp. 418-421, text figs. 1-9.) *Paris.*

Several arenaceous species are recorded and figured in which coccoliths are incorporated as an essential part of the test.

Lacroix, E.
Sur la texture du test de Textularia sagittula *Defrance.*
(Compte rendus des séances Acad. Sci., vol. 184, May 1927, pp. 1202, 1203.) *Paris.*

The occurrence of a chitinous primitive test within the outer calcareous one is noted.

Yabe, Hisakatsu and Shoshiro Hanzawa.
Tertiary Foraminiferous Rocks of the Philippines.
(Proc. Imper. Acad., vol. IV, No. 5, 1928, pp. 222-225.) *Tokyo.*

Preliminary notes to a complete study of a large species of Philippine specimens are given with a list of the large foraminifera already identified.

J. A. C.